REMARKS/ARGUMENTS

The Examiner is thanked for the final Office Action mailed November 12, 2008. The status of the application is as follows:

- Claims 1-20 are pending;
- Claims 1-4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. (WO02/103639A2) in view of Weruaga et al. ("Estimating Volumetric Motion in Human Thorax with Parametric Matching Constraints", June 2003,IEEE Transactions on Medical Imaging, Volume 22, Number 6, Pages 766-772);
- Claims 5-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Weruaga et al. and in further view of Vaillant et al. (US 6,385,285 B1) and Chen et al. ("Kinematic and Deformation Analysis of 4-D Coronary Arterial Trees Reconstruction From Cine Angiograms". June 2003, IEEE, Volume 22, Number 6, Pages 710-721);
- Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Weruaga et al., Vaillant et al., and Chen et al. and in further view of Flohr et al. (US 6,381,487 B1);
- Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Weruaga et al. and in further view of Grangeat et al. ("Theoretical framework for a dynamic cone-beam reconstruction algorithm based on a dynamic particle model", 17 July 2002, Phys. Med. Biol., Volume 47, Pages 2611-2625);
- Claims 9-10 are rejected under 35 U.S.C. 102(b) as being anticipated by Rasche et al.;
- Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Vaillant et al. and Chen et al.;
- Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Hsieh (US 6,529,575 B1);
- Claim 13 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Hsieh and in further view of Miyazaki et al. (US 2002/0032376 A1);
- Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Hsieh and in further view of Vaillant et al. and Chen et al.;
- Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Hsieh;

- Claims 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Hsieh and in further view of Weruaga et al.; and
- Claims 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Weruaga et al.

The rejections are discussed below.

The Rejection of Claims 1-4 under 35 U.S.C. 103(a)

Claims 1-4 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Weruaga et al. This rejection should be withdrawn because the combination of Rasche et al. and Weruaga et al. does not establish a *prima facie* case of obvious with respect to the subject claims.

> The rationale to support a conclusion that the claim would have been obvious is that all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed. *KSR International Co. v. Teleflex Inc.*, 550 U.S. ___ (2007). MPEP §2143.
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> "All words in a claim must be considered in judging the patentability of that claim against the prior art." *In re Wilson*, 424 F.2d 1382, 1385 (CCPA 1970). MPEP §2143.03.

Independent **claim 1** recites, *inter alia*, acquiring **volumetric image data indicative of a moving organ during at least a sub-portion of a movement cycle of the moving organ**, acquiring **a signal indicative of the movement cycle**, and using a similarity measure to **determine motion fields that describe motion of the moving organ during the movement cycle based on the image data and the signal**. The Office asserts that the combination of Rasche et al. and Weruaga et al. teach or suggest the subject claim aspects. However, the combination of Rasche et al. and Weruaga et al. does not teach or suggest the subject claim aspects.

In contrast, Rasche et al. discloses determining motion information based on multiple images, each image being generated from data corresponding to multiple heart cycles or beats, and Weruaga et al. discloses determining motion information between data sets acquired at

different times and thus corresponding to different respiratory cycles. Hence, neither Rasche et al., Weruaga et al. nor the combination thereof teach or suggest determining motion fields that describe motion of a moving organ during a movement cycle of the moving organ based on image data indicative of the moving organ during at least a sub-portion of the movement cycle of the moving organ data and a signal indicative of the movement cycle. Rather, both Rasche et al. and Weruaga et al. disclose determining motion information based on data for a plurality of movement (heart/respiratory) cycles of the moving organ and the plurality of movement cycles.

More particularly, Rasche et al. discloses deriving motion information B from a first image I_1, a second image I_2, a third image I_3, ... (See page 5, lines 28-30). The first image I_1 is generated with data D from first, second, third, ... heart or movement cycles; the second image I_2 is generated with data D from the from first, second, third, ... heart cycles; the third image I_3 is generated with data D from the from first, second, third, ... heart cycles, ... (See page 5, lines 21-27). Thus, the motion information B disclosed in Rasche et al. is based on data indicative of multiple heart or movement cycles. Weruaga et al. discloses a method to compute the spatial correspondence between data sets for different CT scans based on respective breathing cycles. (See Abstract; page 767, section B). Hence, the motion information disclosed in Weruaga et al. is based on data indicative of multiple breathing or movement cycles.

In light of the above, it is readily apparent that neither Rasche et al., Weruaga et al. nor the combination thereof teach or suggest determining motion fields that describe motion of a moving organ during a movement cycle of the moving organ based on image data indicative of the moving organ during at least a sub-portion of the movement cycle of the moving organ data and a signal indicative of the movement cycle, as recited in claim 1. Accordingly, this rejection of claim 1 should be withdrawn.

Claim 2, which depends from claim 1, recites, *inter alia*, that the volumetric image data, which is indicative of a moving organ during at least a sub-portion of **a movement cycle of the moving organ**, corresponds to **cardiac CT data**. Thus, the movement cycle, as claimed in claim 2, corresponds to a single heart beat, as the cardiac cycle is from the beginning of a heart beat to the end of that heart beat. As discussed in connection with claim 1, Rasche et al. and Weruaga et al. disclose determining motion information based on data for multiple movement

cycle; neither teach or suggest determining motion information based on data for a single heart beat. Accordingly, this rejection should be withdrawn.

Claims 3 and 4 depend from claim 1 and are allowable at least for the reasons discussed above in connection with claim 1. Accordingly, the rejection of claims 3 and 4 should be withdrawn.

The Rejection of Claims 5 and 6 under 35 U.S.C. 103(a)

Claims 5 and 6 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Weruaga et al. and further in view of Vaillant et al. and Chen et al. **Claims 5 and 6** indirectly depend from claim 1 and are allowable at least for the reasons discussed above in connection with claim 1. Therefore, this rejection should be withdrawn.

The Rejection of Claim 7 under 35 U.S.C. 103(a)

Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Weruaga et al., Vaillant et al., and Chen et al. and further in view of Flohr et al. **Claim 7** indirectly depends from claim 1 and thus is allowable at least for the reasons discussed above in connection with claim 1. As such, this rejection of claim 7 should be withdrawn.

The Rejection of Claim 8 under 35 U.S.C. 103(a)

Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Weruaga et al. and further in view of Grangeat et al. **Claim 8** indirectly depends from claim 1 and therefore the rejection thereof should be withdrawn for at least for the reasons discussed above in connection with claim 1.

The Rejection of Claims 9 and 10 under 35 U.S.C. 102(b)

Claims 9 and 10 stand rejected under 35 U.S.C. 102(b) as being anticipated by Rasche et al. This rejection should be withdrawn because Rasche et al. does not teach each and every element as set forth in the subject claims and, therefore, does not anticipate claims 9-10.

> A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a

single prior art reference. *Verdegaal Bros. v. Union Oil Co. of California*, 814 F.2d 628, 631 (Fed. Cir. 1987). MPEP §2131.

Independent **claim 9** recites, *inter alia*, an image processor for estimating a motion of an object and determining a plurality of motion fields from volumetric image data and the estimated motion of the object. The Office asserts that Rasche et al. teaches estimating a motion of an object at page 5, lines 14-20, asserting that the subject section of Rasche et al. discloses using an ECG signal to estimate motion by determining phase. Applicants respectfully traverse this assertion. In the subject section, Rasche et al. discloses using the ECG signal to determine "a fixed, temporal delay with respect to the R deflection [of the ECG signal]." The data at each fixed, temporal delay is arbitrarily assigned to a different phase, but no motion is estimated from the ECG signal for any of the phases. In fact, Rasche et al. discloses that data arbitrarily assigned to different phases based on the fixed, temporal delay may end later being assigned to a time window representing the same motion. (See page 6, lines 5-19). The Office further asserts that Rasche et al. teaches determining a plurality of motion fields from volumetric image data and the estimated motion of the object at page 5, lines 28-34, asserting that the motion information B teaches the motion fields. However, the cited section of Rasche et al. discloses deriving the motion information B from low-resolution 3D images, and not from the estimated motion of the object and volumetric image data. Accordingly, Rasche et al. does not teach each and every element as set forth in claim 9 and, thus, this rejection should be withdrawn

Claim 10 depends from claim 9 and thus is allowable at least for the reasons discussed above in connection with claim 9. Therefore, the rejection of claim 10 should be withdrawn.

The Rejection of Claim 11 under 35 U.S.C. 103(a)

Claim 11 is rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Vaillant et al. and Chen et al. **Claim 11** depends from claim 9 and thus the rejection of claim 11 should be withdrawn for at least for the reasons discussed above in connection with claim 9.

The Rejection of Claim 12 under 35 U.S.C. 103(a)

Claim 12 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Hsieh. **Claim 12** recites aspects similar to those recited in claim 9, and the Office

relies on Rasche et al. to teach claim 12. This rejection of claim 12 should be withdrawn for at least the reasons discussed above regarding claim 9.

The Rejection of Claim 13 under 35 U.S.C. 103(a)

Claim 13 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Hsieh and further in view of Miyazaki et al. **Claim 13** depends from claim 12 and therefore the rejection of claim 13 should be withdrawn for at least for the reasons discussed above in connection with claim 12.

The Rejection of Claim 14 under 35 U.S.C. 103(a)

Claim 14 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Hsieh and further in view of Vaillant et al., and Chen et al.. **Claim 14** depends from claim 12 and is allowable at least by virtue of this dependency. As such, this rejection of claim 14 should be withdrawn.

The Rejection of Claim 15 under 35 U.S.C. 103(a)

Claim 15 stands rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Hsieh. **Claim 15** depends from claim 12 and is allowable at least by virtue of this dependency. As such, this rejection of claim 15 should be withdrawn.

The Rejection of Claims 16-18 under 35 U.S.C. 103(a)

Claims 16-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Hsieh and further in view of Weruaga et al. This rejection should be withdrawn because the combination of Rasche et al., Hsieh and Weruaga et al. does not establish a *prima facie* case of obvious with respect to the subject claims.

Claim 16, which depends from claim 12, recites that determining the plurality of motion fields includes estimating a magnitude of the motion based on a difference measure. The Office asserts that Weruaga et al. teaches a magnitude of the motion based on a difference measure at page 767, Section B (Volumetric Motion Estimation) and pages 767-768, Section A (Similarity Operator) and Figure 4. However, these sections and Figure 4 do not teach or suggest the subject claim aspect. Rather, sections A and B disclose determining a similarity operator or coefficient ρ

(which has a value from 0 to 1) that determines the likeness between two data sets (U, V), wherein the closer ρ is to 1, the more alike the two data sets are.

Figure 4 shows in-plane motion for a particular slice and a volumetric inspiration and exhalation envelope. The cited sections and Figure 4 of Weruaga et al. are silent regarding estimating a magnitude of the motion, let alone estimating one based on a difference measure. If the Examiner believes otherwise, applicants respectfully requests that the Examiner provide a specific citation to a line(s) in Weruaga et al. that addresses estimating a magnitude of the motion so that applicants can respond, as the applicants cannot find this aspect in Weruaga et al. and believe that such disclosure is absent from Weruaga et al. In view of the foregoing, applicants respectfully request withdrawal to the rejection of claim 16.

Claim 17, which depends from claim 12, recites that determining the plurality of motion fields includes estimating a magnitude of the motion based on a similarity measure. The Office asserts that Weruaga et al. teaches a magnitude of the motion based on a similarity measure at page 767, Section B (Volumetric Motion Estimation) and pages 767-768, Section A (Similarity Operator) and Figure 4. However, these sections and Figure 4 do not teach or suggest the subject claim aspect. Rather, sections A and B disclose determining a similarity operator or coefficient ρ (which has a value from 0 to 1) that determines the likeness between two data sets (U, V), wherein the closer ρ is to 1, the more alike the two data sets are.

Figure 4 shows in-plane motion for a particular slice and a volumetric inspiration and exhalation envelope. The cited sections and Figure 4 of Weruaga et al. are silent regarding estimating a magnitude of the motion based on a difference measure. If the Examiner believes otherwise, applicants respectfully requests that the Examiner provide a specific citation to a line(s) in Weruaga et al. that addresses estimating a magnitude of the motion so that applicants can respond, as the applicants cannot find this aspect in Weruaga et al. and believe that such disclosure is absent from Weruaga et al. In view of the foregoing, applicants respectfully request withdrawal to the rejection of claim 17.

Claim 18, which depends from claim 12, recites that determining the first time points where the motion of the object is minimal includes comparing the motion fields to a threshold. The Office asserts that Weruaga et al. teaches comparing motion fields to a threshold at page 768, column 1, lines 7-10, page 769, column 1, second line from the bottom, and Figure 4.

Applicants traverse this assertion. First, page 768, column 1, lines 7-10, relates to the similarity operator or coefficient ρ discussed above in connection with claims 16 and 17. For the rejections of claims 16 and 17, the Office states that ρ is used to determine the motion fields. From the subject Office Action, it appears that the Office also asserts that ρ is a motion field. Applicants respectfully request clarification as to whether the Office is alleging that ρ is used to determine motion fields or whether ρ is a motion filed.

Next, ρ is not a motion field, but rather a similarity value between 0 and 1. Page 768, column 1, lines 7-10, discloses comparing ρ to threshold λ to discard low similarities values and does not teach or suggest using ρ to determine first time points where the motion of the object is minimal. Page 769, column 1, second line from the bottom, states that the $\lambda = 0.3$. As such, values of $\rho < 0.3$ are discarded. Weruaga et al. does not expressly or implicitly teach or suggest that that minimal motion occurs for $0.3 < \rho < 1.0$, or any other range of ρ. With respect to Figure 4, as discussed above, Figure 4 shows in-plane motion for a particular slice and a volumetric inspiration and exhalation envelope.

From the foregoing, the cited sections and Figure 4 of Weruaga et al. clearly do not teach or suggest determining the first time points where the motion of the object is minimal includes comparing the motion fields to a threshold. Accordingly, this rejection should be withdrawn.

The Rejection of Claims 19 and 20 under 35 U.S.C. 103(a)

Claims 19-20 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Rasche et al. in view of Weruaga et al. Claim 19 and 20 depend from independent claim 9 and are allowable for at least the reasons discussed above in connection with claim 9.

Conclusion

In view of the foregoing, it is submitted that the claims distinguish patentably and non-obviously over the prior art of record. An early indication of allowability is earnestly solicited

Respectfully submitted,

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